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DEPARTMENT OF COMMERCE

UNITED STATES BUREAU OF MINES
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LOST-TIME ACCIDENTS IN SOME ALABAMA COAL AND IRON MINES DURING 1930[1]

By F. E. Cash[2] and H. B. Humphrey[3]

The following information on accidents in Alabama during 1930 was compiled from data obtained from the companies represented in a course on accident prevention given by the United States Bureau of Mines in Birmingham. These mines produced nearly three-quarters of the tonnage of that State for the year, and included most of the larger operations in the district. The figures are probably representative of the mines which are doing recognized safety work, and are better than the average for all the mines in Alabama.

Table 1 lists the days lost in accordance with the weights given to fatalities and permanent disabilities, part and total, which is the scale used in the National Safety Competition for Mines, conducted by this bureau.

By way of explanation, temporary disabilities are weighted according to actual number of calendar days of disability, including Sundays and holidays -- that is, all days are counted except the day of accident and day of employee's ability to return to duty. Hernia is classed as a temporary disability to be charged with the actual number of calendar days during which the employee was unable to work.

Table 2 gives the number of accidents and the days lost from each cause at 45 coal mines and 7 iron ore mines, also the average frequency and severity rates.

1 - The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6506."

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Table 1.- Scale of time losses for weighting deaths and permanent injuries to show severity of accidents

Nature of injury	Degree of disability in per cent of permanent total disability	Days lost
Death	100	6,000
Permanent total disability	100	6,000
Arm above elbow, dismemberment, or permanent disability of	75	4,500
Arm at or below elbow, dismemberment, or permanent disability of	60	3,600
Hand, dismemberment, or permanent disability of	50	3,000
Thumb, any permanent disability of	10	600
Any 1 finger, any permanent disability of	5	300
2 fingers, any permanent disability of	12½	750
3 fingers, any permanent disability of	20	1,200
4 fingers, any permanent disability of	30	1,800
Thumb and 1 finger, any permanent disability of	20	1,200
Thumb and 2 fingers, any permanent disability of	25	1,500
Thumb and 3 fingers, any permanent disability of	33 1/3	2,000
Thumb and 4 fingers, any permanent disability of	40	2,400
Leg above knee, dismemberment, or permanent disability of	75	4,500
Leg at or below knee, dismemberment, or permanent disability of	50	3,000
Foot, dismemberment, or permanent disability of	40	2,400
Great toe, or any two or more toes, any permanent disability of	5	300
1 toe, other than great toe, any permanent disability of	0	-
1 eye, loss of sight	30	1,800
Both eyes, loss of sight	100	6,000
1 ear, loss of hearing	10	600
Both ears, loss of hearing	50	3,000

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Table 2.- Accident experience of some Alabama coal and iron ore mines in 1930

	Coal	Iron ore
Number of mines	45	7
Production, tons	10,781,718	2,354,251
Average number of men	15,893	1,828
Man-hours exposure	29,257,100	4,059,622
Accidents from falls	490	27
Days lost account of falls	177,497	31,525
Accidents from haulage	487	58
Days lost account of haulage	57,997	19,065
Accidents from electricity	41	1
Days lost account of electricity	60,457	13
Accidents from machinery	110	9
Days lost account of machinery	18,759	6,600
Accidents from explosives	17	4
Days lost account of explosives	13,057	12,103
Accidents from gas and dust	6	—
Days lost account of gas and dust	206	—
Accidents - miscellaneous	562	41
Days lost account of miscellaneous accidents	20,560	1,283
Total accidents	1,713	140
Total days lost	358,035	70,589
Frequency	58.5	34.50
Severity	12.22	15.70
Coal or ore per accident, tons	6,261	16,816
Coal or ore per day lost, tons	30	37
Coal or ore per fatality, tons	291,400	294,281
Fatalities	37	8
Lost-time accidents per fatality	46.3	17.5
Average days lost per accident including fatalities	203.5	504.2

By way of explanation, frequency rate means the number of all accidents (fatal, permanent, and temporary lost-time accidents) per million man-hours of exposure, and severity rate means the number of days of disability resulting from all accidents (fatal, permanent, and temporary lost-time accidents) per thousand man-hours of exposure.

DETAILS OF COAL MINES

The 45 coal mines represented in Table 2 included 1 mine producing less than 10,000 tons per year; 2 mines, 10,000 to 50,000 tons; 7 mines, 50,000 to 100,000 tons; 13 mines, 100,000 to 200,000 tons; 16 mines, 200,000 to 500,000 tons; and 6 mines, more than 500,000 tons.

Table 3 gives the classification with rates and accidents by causes for each class. Only one mine of under 10,000 tons reported working less than 60 days; the next group is insufficiently represented with only two mines, but the other groups include most of the principal producers of Alabama.

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Table 3.- Accidents and rates by classes of coal mines

	Class I 1 mine under 10,000 tons	Class II 2 mines, 10,000 to 50,000 tons	Class III 7 mines, 50,000 to 100,000 tons	Class IV 13 mines, 100,000 to 200,000 tons	Class V 16 mines, 200,000 to 500,000 tons	Class VI 6 mines, 500,000 tons and over	All classes, 45 mines
Coal, tons	1,600	80,300	516,200	1,633,300	4,420,800	4,129,600	10,781,800
Men	50	280	879	3,028	5,887	5,769	15,893
Man-hours	19,600	248,400	1,634,200	5,239,200	11,244,200	10,871,500	29,257,100
Falls	—	8	52	141	236	53	490
Haulage	—	4	41	119	203	120	487
Electricity	—	—	2	20	10	9	41
Machinery	—	1	14	30	39	26	110
Explosives	—	—	2	2	9	4	17
Gas and dust	—	—	—	—	1	5	6
Miscellaneous	—	11	53	153	166	179	562
Total accidents	—	24	164	465	664	396	1,713
Days lost	—	6,395	43,899	70,796	155,255	81,690	358,035
Frequency	—	92.6	100.6	88.7	59.3	36.4	58.5
Severity	—	26.00	26.91	13.51	13.90	7.51	12.22
Fatal	—	1	5	8	14	9	37

Falls.- Falls of rock and coal accounted for 490 of the 1,713 accidents, with 177,497 lost days. These were equivalent to 29 per cent of the accidents and 51 per cent of the days lost, as given in Table 4. Of the 37 fatal accidents, 20 were from this cause, showing that the danger from falls of rock and coal is rightly considered the most serious problem and that the fatal accidents from this source are high in frequency - 20 of 490, or almost 1 in 25.

In frequency, Classes II and III are both equally bad, as given in Table 5, with a rate of 32 accidents per million man-hours; and Class VI leads in safety with a frequency of only 5.

Falls of rock caused 1 fatality in Class II, 4 fatalities in Class III, none in Class IV, 9 in Class V, and 6 in Class VI; this leaves Class VI with the greatest severity rate, 6 fatals in 53 cases. This is an instance of mines with good safety practices and low frequency having much greater severity than more careless mines with greater frequency; the conclusion is that either accident frequency or accident severity alone is not indicative of the effort expended toward accident prevention, although the severity rate would probably show more definitely the comparative working hazard, natural or otherwise.

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Table 4.- Accidents and days lost from different causes in coal mines

Cause	Accidents, per cent of total	Days lost, per cent of total	Fatal accidents
Falls of roof and coal	28.6	50.9	20
Haulage	28.4	16.6	4
Electricity	2.4	17.3	10
Machinery	6.4	5.3	1
Explosives	1.0	3.9	2
Gas and dust	0.4	0.1	-
Miscellaneous	32.8	5.9	-
Total	100.0	100.0	37

Table 5.- Accident frequency by causes in coal mines

	Class				
Cause	II	III	IV	V	VI
Falls	32.2	31.9	27.0	21.1	4.9
Haulage	16.2	25.1	22.8	18.1	11.0
Electricity	0	1.2	3.8	0.9	0.8
Machinery	4.0	8.4	5.7	3.5	2.4
Explosives	0	1.2	0.4	0.8	0.4
Gas and dust	0	0	0	0.1	0.5
Miscellaneous	44.4	32.5	29.37	14.8	16.3

Haulage.- Almost the same number of haulage accidents were reported as falls, — 487 or 28.4 per cent of the total number - but the time lost was much less than from falls, 57,997 days or 16.6 per cent of the total. Class III and IV mines had the greatest frequencies — 25 and 23 accidents per million hours. Again Class VI has the lowest frequency, with 11. In all classes there were four fatal accidents in a total of 487, or 1 in 122 — a good showing. Three of these fatalities were in Class V, giving it the greatest severity rating.

Electricity.- There were 41 electrical accidents equal to 2.4 per cent of accidents from all causes; but electrical accidents caused 17.3 per cent of the lost time, chiefly because of 10 fatalities. These would account for 60,000 of 60,457 days charged to this cause, leaving 31 accidents with only an average lost time of 14 days each. Seven of these fatal accidents were in Class IV, in mines having low, unguarded trolley wire and 13 lost-time electrical accidents. Class III had 2 accidents, 1 of which was fatal; Class V had 10, with 1 fatal, and Class IV had 9, with 1 fatal. The mines in Class IV are responsible for this unnecessarily bad record, chargeable almost wholly to unsafe methods and equipment.

Machinery.- Accidents from machinery were high, reflecting the increase in its use in the district. There were 110 accidents of this type, amounting to 6.4 per cent of all accidents. The time lost was equal to 18,759 days, or 5.3 per cent of the total. Of these 110 accidents only one was fatal, in Class VI. The others average 125 days each.

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Explosives.- Explosives accidents were 17 in number, or 1 per cent of those reported, accounting for 13,057 lost days or 3.9 per cent of the total. There were two fatal cases, which is one in nine; subtracting 12,000 days for these from the total leaves only 1,057 days for the other 15 accidents, averaging 80 days a piece. Nine of these were in Class V, but Class III with two accidents had the greatest frequency of 1.2 per million man-hours.

Gas ignition.- Ignitions of gas caused only six accidents in these mines; this is equal to 0.4 per cent of the total and accounts for 206 lost days, equal to 0.1 per cent. There were no fatalities from this cause.

Miscellaneous.- Approximately one-third of the accidents (562 to be exact) are classed as miscellaneous, with 20,560 days lost time, or 6 per cent of the total days lost. The large number listed under this head is not because the companies did not classify them further, but largely because of different classifications given by different companies.

An average of 35 days lost time per accident indicates that most of these were relatively minor injuries.

General Remarks

As indicated by Table 3, Class II mines (50,000 to 100,000 tons) have the poorest safety record, with a frequency of 100.6 accidents per million hours of exposure and a severity of 26.91 days lost per thousand hours of exposure. This type of mine generally has older and poorer equipment, less adequate supervision, and often a short life in prospect.

Class IV mines (100,000 to 200,000 tons) have a severity rate (13.51) only half as great as that of Class III, and a frequency of 88.7, showing the saving effect of taking more precautions against accidents.

Class V (200,000 to 500,000 tons) has a severity rate (13.90) almost equal to Class IV, with a frequency of 59.3. This relatively high severity is due to nine fatal accidents by rock falls. Without the seven electrocutions in Class IV, mines of that size would have a fine record.

Class VI, comprising the largest mines with production in excess of 500,000 tons, leads in safety with a total severity rate of 7.51 days lost per thousand man-hours exposure, and a frequency of 36.4 accidents per million man-hours. The benefit of adequate supervision and a due regard for safety throughout the organization is apparent.

DETAILS OF IRON-ORE MINES

Less general information is available on the iron-ore mines. The seven mines included in Table 2 were large mines, producing 200,000 to 500,000 tons annually. It is probable that these mines represent closely the average conditions in the iron-ore mines of the Birmingham field. Comparison may be made with the general averages for the coal mines as given in Table 2.

Falls.- There were 27 accidents from falls of rock, or 20 per cent of 140 of all kinds (five of them fatal), or 1 in 5 compared to 1 in 25 for the coal mines. The days lost

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from falls were 31,525 or 44 per cent of the total of 70,589. This greater danger in the ore mines is due to general greater height and a bad draw rock which breaks and falls behind the face, plus the fact that the greater specific gravity of the iron ore and its overlying strata causes more damage than the lighter coal-mine material.

Haulage.- Haulage accidents were more than twice the number of those from falls, amounting to 58 or 41 per cent, with one fatality. The days lost from this cause were 19,065 or 27 per cent of the total. Steep grades, poor clearance, and running cars out of control contribute to this type of accident. Subtracting the lost time charged to one fatality, one permanent total disability, and one permanent partial disability, leaves 4,065 days to 55 cases, an average of 75 days each.

Electricity.- Electricity caused one accident of 13 days lost time.

Machinery.- Machinery was charged with nine accidents, or 7 per cent of the total; one was fatal. The lost time was 6,600 days, an average of 75 days for the nonfatal accidents. Accidents from scraper loading are involved in this class.

Explosives.- Explosives caused four accidents, two of them fatal, with a total lost time of 12,103 days.

Miscellaneous.- There were 41 miscellaneous accidents with 1,283 lost days.

COMPARISON OF COAL AND ORE MINES

The coal mines produced 6,261 tons per accident and the ore mines 16,816 tons - amounts about proportional to the specific gravity of the two products. The coal and ore per day lost were 30 tons for the former mines and 37 tons for the latter mines, and the quantity per fatality was practically the same at a little over 290,000 tons.

There were 46.3 lost-time accidents for each fatality in coal mines, and 17.5 in the ore mines. The total time lost per accident was 203.5 days for coal and 504.2 days for ore.

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